Fritz Neuweiler, Diplom-Geologue,
Dr.rer.nat., Professeur
Fritz.Neuweiler@ggl.ulaval.ca

Faculté des sciences et de génie
Département de géologie et de génie géologique

INVITATION – SOUTENANCE DE THÈSE

Doctorat interuniversitaire en sciences de la Terre (Ph. D.), Université Laval et INRS-ETE
Mardi, 9 mai 2023 à 8h30 à distance *via*
https://ulaval.zoom.us/j/69777707921?pwd=VWcwNENvV0o1TDFMUWRJWTFmc0ViQT09

Chemical composition of scheelite and its application as an indicator mineral

by
Ana Carolina Rodrigues Miranda

Scheelite is a tungsten mineral ($CaWO_4$) that is present in several magmatic and hydrothermal deposits. Because scheelite is a resistant, heavy mineral, and easy to identify due to luminescence propriety, its occurrence in unconsolidated sediments has been used as a tool for targeting tungsten and orogenic Au deposits in areas where the bedrock exposition is rare. Scheelite hosts some key trace elements (Sr, Mo, REE, Na, As) those distribution and concentration are controlled by the geological settings where scheelite formed. Therefore, understanding the factors that control the distribution of trace elements in scheelite provides insights for using scheelite composition to target mineral deposits.

The trace element composition of scheelite associated with the main scheelite-bearing magmatic-hydrothermal deposits such as oxidized and reduced skarns, quartz-vein/greisen Sn-W, porphyry W-Mo and reduced intrusion-related gold systems (RIRGS) are investigated in order to identify the principal factors that control the distribution of minor and trace elements in scheelite. This new data is combined with literature data of scheelite-bearing orogenic Au deposits and investigated using partial least square-discriminant analysis (PLS-DA) to find the chemical variables that allow for discriminating scheelite from different deposit types and use these to target for Au and W ore deposits.

The results show that oxygen fugacity, fluid and intrusion compositions, co-precipitated minerals and fluid salinity are the main parameters that control the incorporation of trace elements in scheelite from magmatic-hydrothermal deposits. The PLS-DA results show that high Mo, As and V contents in scheelite are characteristic of magmatic-hydrothermal deposits formed under high oxygen fugacity such as oxidized skarns, whereas high Nb, Mn, Y and U contents are features of scheelite formed under reduced conditions, which are commonly associated with reduced skarns and quartz-veins/greisen Sn-W deposits. Scheelite from orogenic Au deposits displays predominantly positive Eu anomaly, high Sr and low Mo, Mn and Nb contents which differ from scheelite related to magmatic-hydrothermal deposits. Such differences allow discriminate scheelite associated with orogenic gold from those of magmatic-hydrothermal deposits.

In addition to PLS-DA, two Random Forest models are proposed to assess the source of scheelite and the Au endowment of scheelite-bearing orogenic Au deposits. The high accuracy obtained by the two models enhances the use of trace element in scheelite not only as a robust and efficient tool for targeting scheelite-bearing deposits, but also to assess the fertility of scheelite-bearing orogenic Au deposits.

Membres du jury :
Georges Beaudoin, directeur de recherche, Département de géologie et de génie géologique, Université Laval
Bertrand Rottier, co-directeur de recherche, Département de géologie et de génie géologique, Université Laval
Hélène Legros, Ministère des Ressources naturelles et des Forêts, Canada
Matthieu Harlaux, Bureau de Recherches Géologiques et Minières, France
Marc Constantin, Département de géologie et de génie géologique, Université Laval